

APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: Vehicle Carrying Rail Road Car and Bridge Plate Therefor

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT We,

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have invented a : **VEHICLE CARRYING RAIL ROAD CAR AND BRIDGE
PLATE THEREFOR**

of which the following is a specification.

VEHICLE CARRYING RAIL ROAD CAR AND
BRIDGE PLATE THEREFOR

Field of the Invention

This invention relates to the field of rail road cars for carrying wheeled vehicles.

Background of the Invention

Railroad flat cars are used to transport highway trailers from one place to another in what is referred to as intermodal Trailer-on-Flat-Car (TOFC) service. TOFC service competes with intermodal container service known as Container-on-Flat-Car (COFC), and with truck trailers driven on the highway. TOFC service has been in relative decline for some years due to a number of disadvantages.

First, for distances of less than about 500 miles (800 km), TOFC service is thought to be slower and less flexible than highway operation. Second, in terms of lading per rail car, TOFC tends to be less efficient than Container-on-Flat-Car (COFC) service, and tends also to be less efficient than double-stack COFC service in which containers are carried on top of each other. Third, TOFC (and COFC) terminals tend to require significant capital outlays. Fourth, TOFC loading tends to take a relatively long time to permit rail road cars to be shunted to the right tracks, for trailers to be unloaded from incoming cars, for other trailers to be loaded, and for the rail road cars to be shunted again to make up a new train consist. Fifth, shock and other dynamic loads imparted during shunting and train operation may tend to damage the lading. It would be advantageous to improve rail road car equipment to reduce or eliminate some of these disadvantages.

As highways have become more crowded, demand for a fast TOFC service has increased. Recently, there has been an effort to reduce the loading and unloading time in TOFC service, and an effort to increase the length of TOFC trains. There are two methods for loading highway trailers on flat cars. First, they can be side-loaded with an overhead crane or side-lifting fork-lift crane. Loading with overhead cranes, or with specialized fork-lift equipment tends to occur at large yards, and tends to be capital intensive.

The second method of loading highway trailers, or other wheeled vehicles,

onto rail road cars having decks for carrying vehicles, is by end-loading. End-loading, or circus loading as it is called, has two main variations. First, a string of cars can be backed up to a permanently fixed loading dock, typically a concrete structure having a deck level with the deck of the rail cars. Alternatively, a movable ramp can be placed at one end of a string of rail car units. In either case, the vehicles are driven onto the rail road cars from one end. Each vehicle can be loaded in sequence by driving (in the case of highway trailers, by driving the trailers backward) along the decks of the rail road car units. The gaps between successive rail car units are spanned by bridge plates that permit vehicles to be driven from one rail car unit to the next. Although circus loading is common for a string of cars, end-loading can be used for individual rail car units, or multiple rail car units as may be convenient.

One way to reduce shunting time, and to run a more cost effective service is to operate a dedicated unit train of TOFC cars whose cars are only rarely uncoupled. However, as the number of units in the train increases, circus loading becomes less attractive, since a greater proportion of loading time is spent running a towing rig back and forth along an empty string of cars. It is therefore advantageous to break the unit train in several places when loading and unloading. Although multiple fixed platforms have been used, each fixed platform requires a corresponding dedicated dead-end siding to which a separate portion of train can be shunted. It is not advantageous to require a large number of dedicated parallel sidings with a relatively large fixed investment in concrete platforms.

To avoid shunting to different tracks, as required if a plurality of fixed platforms is used, it is advantageous to break a unit train of TOFC rail road cars on a single siding, so that the train can be re-assembled without switching from one track to another. For example, using a 5000 or 6000 ft siding, a train having 60 rail car units in sections of 15 units made up of three coupled five-pack articulated cars, can be split at two places, namely fifteen units from each end, permitting the sequential loading of fifteen units per section to either side of each split. Once loaded, the gaps between the splits can be closed, without shunting cars from one siding to another. Use of a single siding is made possible by moving the ramps to the split location, rather than switching strings of cars to fixed platforms.

In using movable ramps for loading, the highway trailers are typically backed onto the railcars using a special rail yard truck, called a hostler truck. Railcars can be equipped with a collapsible highway trailer kingpin stand. When the highway trailer is in the right position, the hostler truck hooks onto the collapsible stand (or hitch) and

pulls it forward, thereby lifting it to a deployed (i.e., raised) and locked position. The hostler truck is then used to push the trailer back to engage the kingpin of the hitch. The landing gear of the highway trailer is lowered, and, in addition, it is cranked downward firmly against the rail road car deck as a safety measure in the event of a hitch failure or the king pin of the trailer is sheared off. Once one trailer has been loaded, the towing rig, namely the hostler truck, drives back to the end of the string, another trailer is backed into place, and the process is repeated until all of the trailers have been loaded in the successive positions on the string of railcars. Unloading involves the same process, in reverse. In some circumstances circus loaded flat cars can be loaded with trucks, tractors, farm machinery, construction equipment or automobiles, in a similar manner, except that it is not always necessary to use a towing rig.

From time to time the train consist may be broken up, with various highway-trailer-carrying rail road cars being disconnected, and others being joined. Bridge plates have been the source of some difficulties at the rail car ends where adjacent railroad cars are connected, given the nomenclature "the coupler ends". Traditionally, a pair of cars to be joined at a coupler would each be equipped with one bridge plate permanently mounted on a hinged connection on one side of the car, typically the left hand side. In this arrangement the axis of the hinge is horizontal and transverse to the longitudinal centerline of the rail car.

Conventionally, for loading and unloading operations, the bridge plate of each car at the respective coupled end is lowered, like a draw bridge, into a generally horizontal arrangement to mate with the adjoining car, each plate providing one side of the path so that the co-operative effect of the two plates is to provide a pair of tracks along which a vehicle can roll. When loading is complete, the bridge plates are pivoted about their hinges to a generally vertical, or raised, position, and locked in place so that they cannot fall back down accidentally.

Conventionally, bridge plates at the coupler ends are returned to the raised, or vertical, position before the train can move, to avoid the tendency to become jammed or damaged during travel. That is, as the train travels through a curve, the bridge plates would tend to break off if left in the spanning position between the coupler ends of two rail road cars. Since bridge plates carry multi-ton loads, they tend to have significant structure and weight. Consequently, the requirement to raise and lower the bridge plates into position is a time consuming manual task contributing to the relatively long time required for loading and unloading. Raising and lowering bridge

plates may tend to expose rail-yard personnel to both accidents and repetitive strain injuries caused by lifting.

It would be advantageous to have (a) a bridge plate that can be moved to a storage, or stowed, position, with less lifting; (b) a bridge plate system that does not require the bridge plate to be moved by hand as often, such as by permitting the bridge plate to remain in place during train operation, rather than having to be lowered every time the train is loaded and unloaded, and raised again before the train can move.

Further, a rail road car may sometimes be an internal car, with its bridge plates extended to neighbouring cars, and at other times the rail road car may be an "end" car at which the unit train is either (a) split for loading and unloading; (b) coupled to the locomotive; or (c) coupled to another type of rail road car. In each case, the bridge plate at the split does not need to be in an extended "drive-over" position, and should be in a stowed position. Therefore it is advantageous to have a rail car with bridge plates that can remain in position during operation as an internal car in a unit train, and that can also be stowed as necessary when the car is placed in an end or split position.

However, a bridge plate that is to be left in place to span a gap between adjacent releasably coupled vehicle carrying rail road cars while the train is moving must be able to accommodate relative pitch, yaw, roll and slack action motions between the coupler ends of two adjacent cars during travel. For example, when a train travels through a curve, the gap spanned by the bridge plate on the inside of the curve will shorten, and the gap spanned by the bridge plate on the outside of the curve will lengthen. When passing over switches, the coupler ends of adjacent railroad cars may be subject to both angular and transverse displacement relative to each other. All of these displacements are complicated by the need to tolerate slack action. Slack action includes not only the actual slack in the couplers themselves, but also the run-in and run-out of the draft gear, (or sliding sills, or end of car cushioning devices) of successive rail cars in the train. This combination of displacements does not occur at the articulated connectors between units of an articulated rail road car (which are joined at a common, virtually slackless pin), but does occur at the coupler ends. If the vehicle carrying rail road cars have long travel draft gear, such as sliding sills or long travel end of car cushioning (EOCC) units, the potential range of motion that would have to be tolerated by stay-in-place bridge plates at the "drive-over" coupler ends of railroad cars would be quite large relative to the nominal gap to be spanned with the

cars at an undeflected equilibrium on straight, flat track.

One approach is to reduce the amount and type of train motion to which stay-in-place bridge plates may be subjected. It is advantageous to reduce the amount of slack in the releasable coupling, as by using a low slack, or slackless coupler, and to reduce the travel in the draft gear, as by using reduced travel draft gear. In addition, reduction in overall slack action in the train has a direct benefit in improving ride quality, and hence reducing damage to lading.

One way to reduce slack action is to use fewer couplings. To that end, since articulated connectors are slackless, and since the consist of a unit train changes only infrequently, the use of articulated rail road cars significantly reduces the slack action in the train. Some releasable couplings are still necessary, since the consist does sometimes change, and it is necessary to be able to change out a car for repair or maintenance when required.

Reduction in the travel of draft gear or end-of-car cushioning units (EOCC) runs directly counter to the development of draft gear since the 1920's or 1930's. There has been a long history of development of longer travel draft gear to provide lading protection for relatively high value lading requiring gentler handling, in particular automobiles and auto parts, but also farm machinery, or tractors, or highway trailers. There are, or were, a number of factors that led to this tendency. First, if subject to general classification in a switching yard, the vehicle carrying rail road cars could be coupled to other types of car, rather than merely other vehicle carrying cars. As such, they would be subject to slack run-in (i.e, buff) loads imposed by grain cars, gondola cars, box cars, centerbeam cars, and so on. That is, they were exposed to buff loads from cars having the full range of slack of Type-E couplers, and the full range of travel of conventional draft gear. Second, if subject to flat switching, the often less than gentle habits of rail yard personnel might lead to rather high impact loads during coupling.

In such a hostile operating environment, long travel draft gear or long travel EOCC units are the customary means for protecting the more fragile types of lading. Historically, common types of draft gear, such as that complying with, for example, AAR specification M-901-G, have been rated to withstand an impact at 5 m.p.h. (8 km/h) at a coupler force of 500,000 Lb. (roughly 2.2×10^6 N). Typically, these draft gear have a travel of $2 \frac{3}{4}$ to $3 \frac{1}{4}$ inches in buff before reaching the 500,000 Lb. load, and before "going solid". The term "going solid" refers to the point at which the draft

gear exhibits a steep increase in resistance to further displacement. While deflection of about 3 inches at 500,000 lbs. buff load may be acceptable for coal or grain, it implies undesirably high levels of deceleration or acceleration for more fragile lading, such as automobiles or auto parts. If the impact is sufficiently large to make the draft gear "go solid", then the force transmitted, and the corresponding acceleration imposed on the lading, increases sharply.

Draft gear development has tended to be directed toward providing longer travel on impact to reduce the peak acceleration. In the development of sliding sills, and latterly, hydraulic end of car cushioning units, the same impact is accommodated over 10, 15, or 18 inches of travel. Given this historical development, it is counter-intuitive to employ short-travel, or ultra short travel, draft gear for carrying wheeled vehicles. However, aside from facilitating the use of stay-in-place coupler end bridge plates, the use of short travel, or ultra-short travel, buff gear has the advantage of eliminating the need for relatively expensive, and relatively complicated EOCC units, and the fittings required to accommodate them. This may tend to permit savings both at the time of manufacture, and savings in maintenance during service.

Short travel draft gear is presently available. As noted above, most M-901-G draft gear "go solid" at an official rating travel of 2 $\frac{3}{4}$ " to 3 $\frac{1}{4}$ " of compression under a buff load of 500,000 lbs. Mini-BuffGear, as produced by Miner Enterprises Inc., of 1200 State Street, Geneva Illinois, appears to have a displacement of less than 0.7 inches at a buff load of over 700,000 lbs., and a dynamic load capacity of 1.25 million pounds at 1 inch travel.

In addition to M-901-G draft gear, and Mini-BuffGear, it is also possible to obtain draft gear having less than 1 $\frac{3}{4}$ inches of deflection at 450,000 Lbs., one type having about 1.6 inches of deflection at 450,000 Lbs. This is a significant difference from most M-901-G draft gear.

Furthermore, in seeking a low slack, or slackless train, it is desirable to adopt low-slack, or slackless couplings. Although reduced slack AAR Type F couplers have been known since the 1950's, and slackless "tightlock" AAR Type H couplers became an adopted standard type on passenger equipment in 1947, AAR Type E couplers are still predominant. AAR Type H couplers are expensive, and are used for passenger cars, as are the alternate standard Type CS controlled slack couplers. According to the 1997 Cyclopedia, supra, at p. 647 "Although it was anticipated at one time that the F type coupler might replace the E as the standard freight car

coupler, the additional cost of the coupler and its components, and of the car structure required to accommodate it, have led to its being used primarily for special applications". One "special application" for F type couplers is in tank cars.

5 The difference between the nominal 3/8" slack of a Type F coupler and the nominal 25/32" slack of a Type E coupler may seem small in the context of EOCC equipped cars having 10, 15 or 18 inches of travel. By contrast, that difference, 13/32", seems proportionately larger when viewed in the context of the approximately 11/16" buff compression (at 700,000 lbs.) of Mini-BuffGear. It should be noted that
10 there are many different styles of Type E and Type F couplers, whether short or long shank, whether having upper or lower shelves. There is a Type E/F having a Type E coupler head and a Type F shank. There is a Type E50ARE knuckle which reduces slack from 25/32" to 20/32". Type F herein is intended to include all variants of the Type F series, and Type E herein is intended to include all variants of the Type E
15 series having 20/32" of slack or more.

Stay-in-place bridge plates are intended to accommodate the range of travel defined by the combination of coupler and draft gear, given anticipated service loads. While it may be possible to operate telescoping bridge plates, they are relatively less
20 advantageous than monolithic bridge plates. First, a telescoping device may require a more challenging installation procedure if two sliding parts have to be inserted in each other. Second, the telescoping device must be able to telescope, and yet must also be able to support the vertical load carried on the slide. A slide with significant tolerance may not necessarily support bending moments well, may tend to wear under repeated
25 loading, and may cease to slide very well if damaged or bent due to the vertical loads. A monolithic beam has no moving parts requiring careful manufacturing tolerance, and has no moving parts that may deform and jam in service. Slides may accumulate sand and dirt, and may cease to function if water is able to freeze in the slide.

30 Loading and unloading of highway trailers, or other vehicles in the manner described, above, can also be a relatively tedious and time consuming chore, particularly as the number of railroad cars in the string increases. Persons engaged in such activity may, after some time, perhaps late at night, tend to become less fastidious in their conduct. They may tend to become overconfident in their abilities,
35 and may tend to try to back the highway trailers on to the rail cars rather more quickly than may be prudent. It has been suggested that speeds in the order of 20 km/h have been attempted. In the past, it has been difficult to form bridge plates that lie roughly flush with the deck. Due to their strength requirement, they tend to be about 2 inches

thick or more. As a result there is often a significant bump at the bridge plate. Aggressive loading and unloading of the trailers may cause an undesirable impact at the bump, and loss of control of the load. In that regard, it would be advantageous to reduce the height or severity of the bump. It is also advantageous to employ side sills that have a portion, such as the side sill top chord, that extends above the height of the deck and acts as a curb bounding the trackway, or roadway, defined between the side sills. It is also helpful to have flared sill, or curb, ends that may tend to aid in urging highway trailers toward the center of the trackway along the rail cars.

Demand for transport by TOFC or by container may fluctuate over time. Therefore it would be advantageous to be able to convert a rail road car from one type of service to the other. To that end it would be advantageous to have a rail road car that has structure for either service, and that permits subsequent conversion as may be desired according to market conditions.

Reference is made herein to shipping containers and various sizes of highway trailers. Shipping containers come in International Standards Association (ISO) sizes, or domestic sizes. The ISO containers are 8'-0" wide, 8'-6" high, and come in a 20'-0" length weighing up to 52,900 Lbs., or a 40'-0" length weighing up to 67,200 Lbs., fully loaded. Domestic containers are 8'-6" wide and 9'-6" high. Their standard lengths are 45', 48', and 53'. All domestic containers have a maximum fully loaded weight of 67,200 Lbs. Some common sizes of highway trailers are, first the 28' pup trailer weighing up to 40,000 Lbs., and the 45' to 53' trailer weighing up to 65,000 Lbs. for a two axle trailer and up to 90,000 Lbs. for a three axle trailer.

Summary of the Invention

In an aspect of the invention there is a rail road car bridge plate. It has a beam for spanning a gap between a pair of adjacent rail road cars. The beam has an upwardly facing surface upon which vehicles can be conducted. The beam has a pivot fitting mounted thereto, to permit motion of the beam about an upwardly extending axis.

In another aspect of the invention there is a bridge plate for a vehicle carrying rail road car. The bridge plate has a beam member for spanning a space between two adjacent coupled railroad cars. The beam member has a track surface upon which wheeled vehicles can be conducted. The beam member has a pivot fitting mounted

thereto. The pivot fitting permits movement of the beam about a pivot axis normal to the track surface.

5 In another aspect of the invention there is a rail road car bridge plate operable to permit vehicles to be conducted thereover between respective vehicle decks of a pair of first and second longitudinally coupled rail road cars. The bridge plate has a beam locatable in a longitudinal orientation relative to the rail road cars to span a gap therebetween. The beam has a surface upon which vehicles can be conducted. The beam has a fitting by which to mount the beam to the first of the rail road cars. The
10 fitting permits movement of the beam from the longitudinal orientation to a cross-wise orientation relative to the first rail road car.

15 In an additional feature of that aspect of the invention, the fitting is chosen from the set of fittings consisting of (a) a collar for receiving a pivot pin or (b) a pivot pin engageable in a collar, by which the fitting permits motion of the bridge plate between an extended position spanning a gap between the rail road cars and a storage position. In another additional feature, the fitting is a pivot fitting and, when the beam is lying horizontally, the pivot has a vertical position. In still another additional feature, the beam has a flange defining the surface. The fitting is a pivot fitting
20 having a pivot axis perpendicular to the upper flange. In yet another additional feature, the fitting is a pivot fitting having a pivot axis perpendicular to the surface.

25 In a further additional feature, the surface has traction bars mounted thereto. In still a further additional feature, the second fitting is operable to engage a mating fitting of the second rail road car. In another additional feature, a second fitting is operable to engage the second rail road car. The first fitting is a pivot fitting and the second fitting is a slide fitting. In an additional feature, the second end of the bridge plate has the form of a bifurcated toe. In another additional feature, the beam has at
30 least one hand grab mounted thereto to facilitate manipulation of the bridge plate.

35 In another aspect of the invention, there is a bridge plate for spanning a length-wise gap between corresponding vehicle decks of a pair of first and second releasably coupled rail road cars. The bridge plate has a beam member for supporting the weight of wheeled vehicles. The beam member has an upwardly facing surface upon which vehicles can be conducted between the rail road cars, a first fitting for engaging the first rail road car and a second fitting for engaging the second rail road car. The first fitting is mounted to connect a first end of the beam to the first rail road car. The first fitting permits pivotal motion of the bridge plate about a first axis normal to the

surface relative to the first rail road car. The second fitting mounts to connect a second end of the beam to the second rail road car. The second fitting permits pivotal motion of the bridge plate about a second axis normal to the surface relative to the second rail road car. The second fitting is operable to accommodate variation of distance between the first and second axes while the rail road cars are coupled together and in motion.

In an additional feature, when the rail road cars are uncoupled, the second end of the bridge plate is disengageable from the second rail road car, and is movable about the first axis to a cross-wise storage position. In another additional feature, the second fitting includes a slide capable of linear motion relative to the second axis.

In still another additional feature, the second end of the beam is bifurcated to form a pair of toes and the second fitting is a slot defined between the toes. In still yet another additional feature, the beam includes a top flange, a bottom flange, and webs extending therebetween. In a further additional feature, the second end of the beam has a handgrab to facilitate manipulation of the beam. In yet a further additional feature, the beam has a bottom flange, and a plastic pad mounted to the bottom flange.

In another aspect of the invention, there is a bridge plate for spanning a gap between corresponding vehicle decks of a pair of first and second releasably coupled rail road cars. The bridge plate has a first pivot fitting mountable to the first rail road car. The pivot fitting permits pivotal motion of the bridge plate relative to the first rail road car about a first vertical axis. It has a second fitting for engaging the second rail road car. The second fitting includes a linear extension member permitting pivotal motion of the bridge plate relative to a second vertical axis fixed relative to the second rail road car. The linear extension member tolerates variation in distance between the first and second axes.

In an additional feature of that aspect of the invention, the bridge plate is a beam having an upper flange, a lower flange, and vertical webs extending therebetween. In another additional feature, a slider pad is mounted to the bottom flange. In still another additional feature, the linear extension member is a slot defined in the beam.

In another aspect of the invention, there is a bridge plate kit for spanning a gap between a pair of first and second releasably coupled rail road cars. The kit has a bridge plate. A first pivot pin has a first pivot axis. The first pivot pin is mountable

to the first rail road car with the first pivot axis in a vertical orientation. A second pivot pin has a second pivot axis. The second pivot pin is mountable to the second rail road car with the second pivot axis in a vertical orientation. A bridge plate has a first fitting in engagement with the first pivot pin. The bridge plate is pivotable relative to the first pivot axis. A second fitting is in engagement with the second pivot pin. The bridge plate is pivotable relative to the second axis, and the bridge plate is translatable relative to the second axis.

In an additional feature, the first fitting is a collar matable with the first pivot pin. The second fitting is a guide matable with the second pivot pin. In another additional feature, the bridge plate includes a beam member for supporting loads to be conducted between the first and second rail road cars. The first fitting is a collar mounted to the first pivot pin. The second fitting is an elongated slot. The second pivot pin is seated in the slot. In still another additional feature, the bridge plate includes a beam member for supporting loads to be conducted between the first and second rail road cars. The beam has a pair of toes at one end thereof. The second fitting is an open ended slot defined between the toes. In still yet another additional feature, the second pivot pin is removable from the second mounting. The bridge plate has hand grabs to facilitate pivoting of the bridge plate by hand about the first pivot pin.

In yet another additional feature, the kit includes two of the bridge plates. Two of the first fittings and two of the second fittings, when installed, co-operate as a pair of side-by-side wheel trackways to define a pathway between the first and second rail road cars.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1a shows a conceptual side view of a train having several articulated vehicle carrying rail road cars, in an unloaded condition;

Figure 1b shows a portion of the train of Figure 1a as split for loading;

Figure 1c shows the train portion of Figure 1a in a split configuration ready for loading;

Figure 1d shows the train portion of Figure 1a in a partially loaded condition;

Figure 1e shows the train portion of Figure 1a in a fully loaded condition;

Figure 1f shows portions of the train of Figure 1a in an assembled condition;

Figure 2a shows a side view of a five-pack articulated railroad car for carrying highway trailers as loaded;

Figure 2b shows a top view of the five pack articulated rail road car of Figure 2a in an unloaded condition;

Figure 2c shows a side view of the rail road car of Figure 2a in an unloaded condition;

5 Figure 3a shows an isometric view of a "B-End" unit of an articulated rail road car such as shown in either Figure 1a or Figure 2a, with middle floor deck plates removed for clarity;

Figure 3b shows a top view of the articulated rail road unit car of Figure 3a;

Figure 3c shows a side view of the articulated rail car unit of Figure 3a;

10 Figure 3d shows an underside view of the rail road car unit of Figure 3a;

Figure 3e shows an end view of the articulated rail road car unit of Figure 3a;

Figure 3f shows a mid-span cross-section of the rail road car unit of Figure 3a;

Figure 3g shows an enlarged side detail of the rail car unit of Figure 3a at the coupler end of the car;

15 Figure 3h shows an enlarged top detail of the rail car unit of Figure 3a;

Figure 4a shows a top view of a bridge plate for the rail car unit of Figure 3a;

Figure 4b shows a side view of the bridge plate of Figure 4a;

Figure 4c shows an end view of the bridge plate of Figure 4a;

Figure 4d shows a section of the bridge plate of Figure 4a taken on '4d - 4d';

20 Figure 4e shows a section of the bridge plate of Figure 4a taken on '4e - 4e';

Figure 5a is a partial isometric view of the bridge plate of Figure 4a in an extended position relative to the rail car unit of Figure 3a;

Figure 5b is a partial isometric view of the bridge plate of Figure 4a in a stored position relative to the rail car unit of Figure 3a;

25 Figure 5c is a top view of the bridge plate of Figure 5a showing in service deflection;

Figure 6a is an isometric view of a transition bridge plate for the rail car unit of Figure 3a;

Figure 6b is a top view of the transition bridge plate of Figure 6a;

30 Figure 6c is a side view of the transition bridge plate of Figure 6a;

Figure 7a is an isometric view of a cam crank of the rail car unit of Figure 3a;

Figure 7b is a side view of the cam crank of Figure 7a;

Figure 7c is an end view of the cam crank of Figure 7a;

Figure 7d is a cross-section of the cam crank of Figure 7a taken on '7d - 7d';

35 Figure 7e is a view of the cam crank of Figure 7a taken on arrow '7e';

Figure 7f shows a partial cross-section of the rail car unit of Figure 3a taken on '7f - 7f' showing the cam crank of Figure 7a installed;

Figure 7g shows a partial sectional view across the rail car unit of Figure 3a with the cam crank of Figure 7a installed;

Figure 8a shows a partial side sectional view of two rail road cars having bridge plates, as shown in Figure 7a, in a separated position;

Figure 8b shows the rail road cars of Figure 8a in an approach position;

Figure 8c shows the rail cars of Figure 8a as one bridge plate meets a cam crank;

Figure 8d shows the rail cars of Figure 8a in a coupled relationship;

Figure 8e shows the rail road cars of Figure 8a in an alternate approach position to that of Figure 8b;

Figure 8f shows the rail cars of Figure 8e as one bridge plate meets a cam crank;

Figure 9a shows an isometric view of a 'A-End' unit of the articulated rail road car of Figure 1a with middle floor deck plates removed for clarity;

Figure 9b shows a top view of the articulated rail road unit car of Figure 9a;

Figure 9c shows a side view of the articulated rail car unit of Figure 9a;

Figure 9d shows an underside view of the rail road car unit of Figure 9a;

Figure 10a shows an isometric view of an intermediate "C" unit of the articulated rail road car of Figure 1a with middle floor deck plates removed for clarity;

Figure 10b shows a top view of the articulated rail road unit car of Figure 10a;

Figure 10c shows a side view of the articulated rail car unit of Figure 10a;

Figure 10d shows an underside view of the rail road car unit of Figure 10a;

Figure 11a shows a top view of the draft gear at the coupler end of the articulated rail road car of Figure 3a; and

Figure 11b shows a sectional of the draft gear of Figure 11a taken on '11b - 11b'.

DETAILED DESCRIPTION OF THE INVENTION

The description that follows, and the embodiments described therein, are provided by way of illustration of an example, or examples of particular embodiments of the principles of the present invention. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the invention. In the description, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings are not

necessarily to scale and in some instances proportions may have been exaggerated in order more clearly to depict certain features of the invention.

In terms of general orientation and directional nomenclature, for each of the rail road cars described herein, the longitudinal direction is defined as being coincident with the rolling direction of the car, or car unit, when located on tangent (that is, straight) track. In the case of a car having a center sill, whether a through center sill or stub sill, the longitudinal direction is parallel to the center sill, and parallel to the side sills, if any. Unless otherwise noted, vertical, or upward and downward, are terms that use top of rail, **TOR**, as a datum. The term lateral, or laterally outboard, refers to a distance or orientation relative to the longitudinal centerline of the railroad car, or car unit, indicated as **CL - Rail Car**. The term "longitudinally inboard", or "longitudinally outboard" is a distance taken relative to a mid-span lateral section of the car, or car unit. Pitching motion is angular motion of a rail car unit about a horizontal axis perpendicular to the longitudinal direction. Yawing is angular motion about a vertical axis. Roll is angular motion about the longitudinal axis.

By way of general overview, Figures 1a to 1f illustrate the process of loading wheeled vehicles onto a train of multi-unit articulated railroad cars. In this example, an assembled train of articulated rail road cars, indicted generally as **20**, includes a string of three-pack articulated railroad cars **21**, **22**, **23** and **24** joined together with a two rail car unit articulated rail road car **25**, drawn by a locomotive indicated as **38**. Train **20** travels in a longitudinal direction toward its destination. While train **20** is travelling, bridge plates **150** (described more fully below) remain extended in a length-wise (i.e., longitudinal) "drive-over" orientation, such as shown in Figure 5a below, to span the gap at the releasable coupling between the decks of the adjacent rail car units of rail road car **21** and rail road car **22**, as well as between rail road cars **23** and **24**, **24** and **25**. At the coupled connection between rail road cars **22** and **23**, bridge plates **150** do not extend lengthwise but are disposed in a stowed, cross-wise orientation, transverse to the longitudinal centerlines of the rail road cars, as shown in Figure 5b below. Likewise, at the ends of the string of vehicle carrying rail road cars, such as adjacent locomotive **38**, at the end of train location, (or, in another context, at a car coupled to a different type of freight car), bridge plates **150** are also placed in their stowed position, as in Figure 5b. It is preferred that train **20** be a unit train composed of vehicle carrying rail road cars, and not coupled to any other type of car.

In the second, enlarged, partial view of Figure 1b, train 20 has arrived at its destination, and a rear portion 27 of train 20 has been spotted at a first location, while another, more forward portion 29 has been spotted further along the track. The two portions are separated by a few hundred feet. Train 20 has been split at the releasable coupling between the rear end unit of rail road car 22 and the forward end unit of rail road car 23. In the separated position of Figures 1b, 1c, 1d, and 1e, the cross-wise stowed orientation of the bridge plates at the opposing ends of rail road cars 22 and 23 facilitates use of movable ramps 59 for loading, or unloading, of train 20. As shown in the succession of views of Figures 1c, 1d, 1e and 1f, hostler trucks 40 are used to move ramps 59 into place adjacent the split, (i.e., uncoupled), ends of rail road cars 22 and 23, and are then used to back wheeled vehicles, in this instance highway trailers 42, into place, each highway trailer 42 facing the split, with its king pin engaging the hitch plate of a collapsible hitch 112 or 114 (see below), and its landing gear cranked firmly down. (Other types of wheeled vehicles, whether automobiles, trucks, farm machinery, or buses could be loaded in a similar manner, with or without a towing tractor, as may be suitable). At the internal ends of rail road cars 21, 22, 23, 24, and 25, the length-wise extended bridge plates make those ends "drive-over" ends that permit highway trailers to be conducted along a continuous path between cars.

When all of the rail car units have been loaded, train 20 is ready. The split, (or splits, as the case may be) can be closed by gently shunting the forward and rearward portions 29 and 27 together. Train 20 is then ready to depart for its next destination. In the example train 20 arrives empty. However, it would be customary for the loading procedure described to have been preceded by an unloading procedure for highway trailer units arriving from the previous depot, as by reversing the steps of Figures 1e, 1d, 1c and 1b.

Describing elements of train 20 in greater detail, coupled units 22 and 23 have respective first, or "drive over" end units 26, and 28, intermediate articulated units 30 and 32, and coupled end units 34 and 36. For the purposes of this description, it can be taken that units 26 and 28 are the same, units 30 and 32 are the same, and units 34 and 36 are the same, but facing in opposite directions. Each of the rail car units having a coupler end, namely units 26 and 28, 34 and 36, has an end truck, 35, mounted under a main bolster at the coupler end, whichever end it may be. Rail car units 26 and 30, 30 and 34, 36 and 32, and 32 and 28 are joined together by articulated connectors indicated generally as 37, mounted over respective shared articulated connection trucks 39. Rail car units 34 and 36 are connected by releasable couplers 44 and 46. Articulated connector bridge plates 300 (whether left or right

handed, as described below) span the gaps between rail car units 26 and 30, 30 and 34, 36 and 32, and 32 and 28. With the aid of articulated connector bridge plates 300, and movable bridge plates 150, to one side of the split between rail road cars 22 and 23, decks 47, 48, 49, 50, 51, and 52, (and to the other side, 47, 48, 49, 50, 51, 52, 53 and 54) form continuous pathways, or roadways, upon which vehicles can be conducted in either forward, driving, direction or a reverse, backward direction. If additional railroad cars are joined at the opposite ends of railroad cars 22 and 23, further bridge plates can be employed to extend the length of the pathway.

For the purposes of this description, although Figures 1a, 1b, 1c, 1d, 1e, and 1f show a locomotive and three-pack or two-pack articulated cars, other combinations of articulated cars having any reasonable number of articulation units can be employed. 2-unit, 3-unit, and 5-unit articulated packs are relatively common. It will be understood that the example of Figures 1a – 1f is meant symbolically to represent a train of any suitable length. Typically, a unit train would include a much larger number of cars units, such as 60 or 80 rail car units composed of a multiplicity of 2, 3, 5 or 6 (or more) unit articulated cars strung together. Such a train can be directed onto a siding, with successive portions of the string spotted at different locations along the siding, leaving gaps of, typically, 200 or 300 feet between sections to permit the placement of ramps as may be suitable. When the cars are loaded, the ramps are removed. The locomotive can then reverse, closing each successive gap and permitting the rail road cars to be reconnected at their respective coupler ends.

In the example shown, end rail car units 26 of rail road car 21, and 28 of rail road car 25, each have a movable bridge plate 150 carried at their uncoupled ends (in the case of rail car unit 26, the “uncoupled end” is actually coupled to locomotive 38, the context of “uncoupled” meaning an end that is not coupled to another similar rail car for carrying vehicles to which a bridge plate would be extended). If a larger train were assembled, the uncoupled ends of car units 26 and 28 would be coupled to mating ends of other articulated cars. When additional cars are joined, the collapsible hitches are oriented in the same direction, namely, all facing toward the location of the split. Thus, away from the split, a car unit 26 would mate with a car unit like car unit 34, and so on. In a long train there would tend to be more than one split.

For the purposes of illustration, rail road car 22, which includes rail car units 26, 30, and 34 will be described in greater detail. It will be appreciated that a two-unit articulated rail road car, such as rail road car 25, can be assembled by joining units 26 and 34 directly together, and that, in general, articulated rail cars of varying lengths

can be assembled from a pair of ends units, such as units 26 and 34, and any chosen number of intermediate units (i.e., cars not having coupler ends) such as unit 30. A five-pack assembled in this way is shown loaded in Figure 2a, and unloaded in Figures 2b and 2c. For the purposes of this description, unit 26 is arbitrarily designated as the "A-End" unit, unit 34 is the "B-End" unit, and unit 30 is the "C", or intermediate unit. In rail road terminology the "B" end of a rail road car is the handbrake end, or predominant hand brake end. When several "C" units are employed in a multi-unit articulated rail road car, as in the five pack of Figures 2a, 2b and 2c, each may be referred to as the "C", "D", or "E" unit (and so on if more units are used). There are minor structural differences between the intermediate units, such as whether one hitch is provided or two, and corresponding cross-bearer and deck web reinforcements. For the purposes of this structural description any intermediate car unit will be referred to as a "C" unit, and unit 30 will be taken as representative of intermediate units in general, whatever their hitch layout may be.

The second end unit (the "B" unit) 34 is shown in Figures 3a, (isometric, with decking partially removed to reveal deck supporting structure), 3b (side) 3c (top view, with decking partially removed to reveal structure) 3d (underframe) and 3e (coupler end view). Car unit 34 has a main longitudinal structural member in the nature of a main center sill 60 having a draft pocket 62 at one end (i.e., the "coupler end" portion, 64 of unit 34), and an articulated connector socket in the nature of a rectangular fabricated steel box 66 into which one half of an articulated connector 68 is mounted at the other end (i.e., the articulated connection end portion, 70 of car unit 34). In between the coupler end portion 66 and the articulated end portion 70 is a central portion, 72, being the mid-span portion of the car between its trucks.

As shown in the offset section of Figure 3f, over the central portion 72, of unit 34 center sill 60 has the form of a hollow beam having a top flange 74, a bottom flange 76, and a pair of spaced apart vertical webs 78, 80. A set of cross-bearers 82 extend outwardly from roots at the side webs of center sill 60 to laterally outboard ends that meet in lap welded joints with vertical gussets 83 of meet side sills 84 and 86. Each of side sills 84 and 86 has a hollow rectangular top chord member 90, an outer cowling sheet, or web 92, a bottom chord in the form of an angle 94, and a cross-bearer flange extension 96 in the form of a bent member welded to the inner face of top chord member 90 in a downwardly hanging position, the upward portion, or leg of extension 96 lying on the same slope as the top chord web, the inwardly extending portion, or leg, of extension 96 lying roughly horizontally to provide a lip that is welded to the top flange of the cross-bearer.

Floor panels 100 span the pitches between cross-bearers 84, to provide a continuous pathway from one end of the car to the other. Each floor panel 100 is formed from a series of spaced apart, longitudinally extending channels 102, 103, 104 surmounted by a top sheet, or flange 106 whose upper surface 108 forms a path for the wheels of vehicles loaded on the car unit. Upper surface 108 is roughly flush with top flange 74 of center sill 60, and floor panels 100 and top flange 74 co-operate to form deck 47 of rail car unit 34. Side sills 84 and 86, run along the sides of deck 47. Top chord member 90 of each of side sills 84 and 86 extends well above the level of top surface 108, and serves as a curb to encourage trailers to stay on the trackway, or roadway, defined on deck 47 between top chord members 90, as they are backed along the rail car unit.

Each of side sills 84 and 86 is canted inwardly, such that its lower extremity, or toe, is nearer to the rail car longitudinal centerline than the top chord. The inward cant of top chord member 90 of side sills 84 and 86 gives this curb an angle or chamfer, as shown in Figure 3f, such that a truck tire must ride up the slope before it can escape, the chamfer yielding a self-centering effect as the tires try to ride along it. Although only a few floor panels 100 are shown, it will be appreciated that floor panels 100 are located continuously to permit vehicles to be driven over the car units, as in Figure 2b.

At either end of the central portion of car unit 34, there are dual purpose cross-beams 109, 110 located at longitudinal stations corresponding to the 40 ft container pedestal locations of a container carrying rail car.

A first collapsible hitch 112 is also mounted to top flange 74 of center sill 60 in a mid span position for engaging a 28' pup-trailer, if required. A second collapsible hitch 114 is mounted roughly 4 inches inboard from the truck center, CL Truck, at coupler end, end portion 64. The cross-bearer flanges are reinforced under the hitch locations, as shown at 116.

At the coupler end, end portion 64, main center sill 60 of rail car unit 34 becomes shallower, the bottom flange being stepped upwardly to a height suitable for being supported on truck 35. Side sills 84 and 86 also become shallower as the bottom flange curves upward to clear truck 35. Rail car unit 34 has a laterally extending main bolster 120 at the longitudinal station of the truck center (CL Truck), and a parallel, laterally extending end sill 122 having left and right hand arms 121,

123 extending laterally between the coupler pocket and the side sills. In their distal, or outboard regions, arms 121 and 123 have ramp engagement sockets 125 in the nature of rectangular apertures, with which prongs 127 of ramp 59 can be engaged to align ramp 59 with car unit 34 for loading.

As shown in Figure 7g, top flange 74 of center sill 60 has a downwardly sloping transition 124 longitudinally outboard of main bolster 120, and a level, horizontally extending portion 126 lying outboard thereof, such that the end portion of center sill 60 is stepped downward relative to the main portion of top flange 74 inboard of bolster 120. A bridge plate support member, in the nature of an outboard horizontal shelf portion 134, includes left and right hand plates 128, 130 that form upper flanges for, and extend longitudinally inboard of, arms 121 and 123 of end sill 122 to define bridge plate support members.

A laterally extending structural member, in the nature of a fabricated closed beam 136 is welded to horizontal portion 126 of center sill 60 between side sills 84 and 86. Beam 136 has vertical legs 138 extending upwardly of portion 126 and a horizontal back 140, lying flush with the level of top flange 74 at the longitudinal location of main bolster 120. Left and right hand deck plates 141 are welded to back 140 and extend above tapered portion 130 to terminate at main bolster 120.

Plates 128 and 130 are flush with downwardly stepped horizontal portion 126 of top flange 74, and co-operate with portion 126 to define a continuous shelf across (i.e., extending cross-wise relative to) the end of rail car unit 34, outboard of the end of deck 47 defined by the longitudinally outboard edge of beam 136. In this way a step, depression, shelf, or rebate, or recess 142 for accommodating (or for receiving) a bridge plate, is formed in the end of rail car unit 34 adjacent to the coupler 144, upon which bridge plate 150 can rest, as described below.

When seen from above, as in Figure 3h, the outboard end portions 146 and 148 of side sills 84 and 86, respectively, are splayed laterally outward to give a flared end to the pathway, trackway, or roadway, defined between the curbs of their respective top chord members 90. The flare is achieved with a mitre, or chamfer, but could also be achieved with a smooth curve, and serves to provide a lead-in for truck wheels to the straight curb portions of top chord members 90 and to allow motion of the bridge plates during operation, as indicated in Figure 5c.

A gap spanning structural member, or beam, namely bridge plate 150, is

indicated in Figures 4a, 4b, 4c, and 4d. Bridge plate 150 is preferably of steel construction, but could be of aluminum, or suitable reinforced engineered plastics, to reduce the weight to be manipulated by railyard crews. Bridge plate 150 has the construction of a rigid flanged beam, having a top flange, or sheet 152, upon whose upper surface 154 vehicles can be conducted. Sheet 152 is backed by a pair of spaced apart, longitudinally extending channel members 155 and 156, welded with toes against sheet 152. A pair of formed angles 158 and 160 are welded laterally outboard of channel members 155 and 156, and a plate 162 is welded to span the gap between the backs of channel members 155 and 156. In this way plate 162, the backs of channel members 155 and 156, and the horizontal legs 164 and 166 of formed angles 158 and 160 act as a bottom flange in opposition to the top flange, sheet 152, with the other legs and toes acting as vertical shear transfer webs. A traction enhancement means is provided to give bridge plate 150 a non-smooth, or roughened track, in the nature of laterally extending, parallel, spaced tread bars 168 welded to the mid-span portion of sheet 152.

At one end, defined as the proximal, or inboard end, 170 bridge plate 150 has a pivot fitting, in the nature of a pair of aligned holes 172, 173 formed in sheet 152 and plate 162 to define a hinge pin passage. The axis 174 of the passage formed through hole 172 is normal (i.e., perpendicular) to upper surface 174 of sheet 152, and, in use, is ideally vertical, or predominantly vertical given tolerance and allowance for yaw, pitch, and roll between the rail road cars. Proximal end 170 is chamfered as shown at 176, 178 and is boxed in with web members 180, 182. Although a mitre is preferred for simplicity of manufacture, either end of bridge plate 150 could have a rounded shape, rather than a mitre.

At the other end, defined to be the distal, or outboard end, 184, bridge plate 150 is bifurcated, having a linear expansion member in the nature of a longitudinally extending guideway, or slot, 186, defined between a pair of tines, or toes 188, 190, each having an external chamfer as shown at 192, 194. The distal ends of channel members 154, 156 are also boxed in at distal end 184 as shown at 196. A web member, in the nature of a gusset 198 is welded between the facing walls of channels 155 and 156, adjacent to the groin of slot 186, to encourage toes 188 and 190 to maintain their planar orientation relative to each other.

As shown in Figures 5a, bridge plate 150 can be mounted in an employed, drive-over, or length-wise extended position, in which distal end 184 is located longitudinally outboard of end sill 122, and in which the longitudinal axis of bridge

plate 150 is parallel to the longitudinal centerline axis of car unit 34 (on straight track, but otherwise depending on pitch and yaw between cars) to permit vehicles to be conducted between cars. Bridge plate 150 can also be mounted in a stowed, lateral, transverse or cross-wise position, as shown in Figure 5b, in which the centerline of bridge plate 150 is perpendicular to the longitudinal centerline of car unit 34.

Shelf portion 134 has a first bore formed therein to one side of longitudinal centerline of unit 34. A pivot fitting, or mounting fitting, in the nature of a collar 200 is mounted flush with, or slightly shy of the upper surface of shelf portion 134, at a first location, indicated as bore 202, for alignment with through hole 172. As discussed below in the context of Figures 8a - 8c the toe of bridge plate 150 can be tipped up slightly. To do this, the rear, or longitudinally inboard edge of shelf portion 134 acts as a fulcrum. A retaining member, in the nature of a hinge pin 204, is fabricated from a section of pipe 206 of a size permitting a loose fit within collar 200 to allow for roll, pitch and yaw between cars. Pipe 206 has a flange 208 mounted at one end, the proximal or upper end. Flange 208 bears on sheet 152 to prevent pipe 206 from falling through collar 200. Pin 204 also has a lifting fitting in the nature of an internal cross bar 209 mounted at the flanged end. Bar 209 is grasped to withdraw pin 204 (or 205, below). The distal or lower end of pipe 206 is slotted to accept a transverse pin 210, itself held in place by a locking member in the nature of a cotter pin, that prevents hinge pin 204 from unintentionally lifting out of collar 200. Shelf portion 134 also has an abutment, or stop, not shown, welded to the upper surface of plate 130 to prevent bridge plate 150 from being pivoted past the stowed position, and so preventing the side of bridge plate 150 from hitting cam crank 241 (described below) inadvertently if transition plates 232 is in the raised position (also described below).

When hinge pin 204 is in place, bridge plate 150 is restricted, or constrained, within the limits of a loose fit, to a single degree of freedom relative to rail car unit 34, namely pivotal motion about a vertical axis. The sloppy, or loose, fit of hinge pin 204 within collar 200 gives a limited amount of play to permit tipping the bridge plate upward during coupling, and to permit sufficient roll, pitch and yaw for normal railroad operation. In the preferred embodiment, a nylon (t.m) pad 211 is mounted to the underside of bridge plate 150 to provide a bearing surface for riding against shelf portion 134. In alternative embodiments other types of relatively slippery, high density, or UHMW, polymer materials could be used.

Shelf portion 134 of shear plate 130 has a second bore formed therein offset to

the other side of longitudinal underside of car unit 34. As shown in Figure 7g, another collar 200 is mounted to the underside of, and flush with (or, shy of) plate 128 of shelf portion 134 at a second location, indicated as bore 214, at the same longitudinal station as bore 202 for alignment with slot 186 when bridge plate 150 is in the lateral, or storage, position resting fully on shelf portion 134. Another hinge pin 205, of the same construction as pin 204 described above, is provided to secure bridge plate 150 in the stowed position, the distal end of pin 205 locating in bore 202 and the proximal end locating in slot 186 defined between toes 188, 190. When hinge pin 205 is removed, bridge plate 150 is able to pivot about the hinge formed by the co-operation of hinge pin 204, collar 200 and through hole 172.

When a bridge plate such as bridge plate 150 is in the extended (i.e., lengthwise, or longitudinal) position, and its distal end (or tip) engages the adjacent car, pin 205 is again used, this time to provide a positive, securing, retaining, indexing, or alignment member to the engaging fitting, namely slot 186. Slot 186 is then constrained, within the confines of a loose fit, to permit motion along a first linear degree of freedom, namely to slide as the gap between cars shortens and lengthens as adjacent rail car units yaw, or translate transversely, relative to each other, and a rotational degree of freedom relative to the locating pin, i.e., pin 205, of the adjacent car. As above, the loose fit of pin 205 in slot 186 allows for normal pitch and roll motion of the cars. As shown in Figure 5c, the combination of a rotational degree of freedom at pin 204 of one rail road car, and both rotational and linear displacement at pin 205 of the other rail road car, accommodates both curving and transverse displacement of the coupler ends relative to each other. That is, the interaction of slot 186 with pin 205 provides both a pivot fitting for accommodating yawing motion of the adjacent rail road car, but also provides a linear expansion member for accommodating variation in distance between the respective vertical axes of pin 204 (and, collar 200) of one rail road car, e.g., car 22, and pin 205 (and its collar 200) of the adjacently coupled rail road car, e.g., car 21.

When viewed in Figure 4a it can be seen that bridge plate 150 has cut-outs 216, 218 formed in its distal end to accommodate cam crank 241 (described below) when bridge plate 150 is in the stowed position, and a pair of hand hold rungs 220, 222 mounted to the chamfer of toes 188, 190 to facilitate pulling of bridge plate 150 from the stowed position, and to facilitate tipping the distal end, or toe, of bridge plate 150 upward, preparatory to coupling two rail car unit coupler ends together.

Left and right hand transition plates are shown in Figure 6a, 6b, and 6c as 230,

232. Each has pivot fittings in the nature of arcuate hinge tangs 234, 236 extending from proximal edge 235. Hinge tangs 234, 236 locate in corresponding apertures, namely rectangular slots 238, 240 (Figure 7g) formed in back 140 of formed channel 136. Hinge tangs 234, 236 and slots 238, 240 co-operate to permit upward lifting of their distal tips by pivotal motion of each of transition plates 230, 232 about a horizontal pivot axis lying perpendicular to the longitudinal centerline of rail car unit 34. As above, there is tolerance in the fit of tangs 234, 236 and slots 238, 240 to allow for normal railcar motion. Transition plates 230 and 232 cover the gap that could otherwise exist between the inboard, or proximal end of bridge plate 150 (on one side, i.e., 230) or the toes of the bridge plate of the adjoining rail car (on the other side, i.e., 232) and the end of deck 47 of rail car unit 34. Since transition plates 230 and 232 are relatively thin (5/8 inch) they do not present a large bump when highway trailer wheels encounter them. Transition plates 230, 232 each have a U-shaped central relief 237 formed in distal portion 239 to avoid fouling pin 204 (or 205).

In the preferred embodiment, the upper surface of bridge plate 150 is roughly flush with the level of the adjacent end of deck 47, as taken at the height of the upper surface of the top flange fabricated cross-beam 136, such that a generally level roadway is formed. It is possible to conduct highway trailers from bridge plates 150 to deck 47 without the use of transition plates 230, 232, but is more advantageous to use transition plates. It is also not necessary that the depth of shelf portion 134 relative to the end of the deck, (i.e., the height of the step) indicated as D_1 , be the same as the depth of bridge plate 150, indicated as D_2 . It is advantageous that the height differential between the top of bridge plate 150 and the end of deck 47 be small, such as less than 1 - 1/2 inches, and better still, less than 1/2 inch to reduce the potential bump. The severity of the bump is also reduced by the use of transition plates 230, 232, that permit a mismatch in height to be taken up over a modest longitudinal distance, rather than suddenly.

It is also possible to use a bridge plate support member other than shelf portion 134. For example, a cross-beam or cantilevered beam could be used, whether mounted to end sill 122, center sill 60, side sills 84, 86 or some combination thereof. Alternatively a pedestal could be employed having an upwardly protruding pin in place of pin 204, and an alternative form of second retainer in place of pin 205, such as one or more retractable abutments, whether spring loaded or otherwise in the manner of spring loaded detents, or a releasable hook or latch, could be used to similar effect. The use of a bridge plate kit including bridge plate 150 and pins 204 and 205 is advantageous since pins 204 and 205 are interchangeable, are used to

provide motion tolerant retention of the proximal end (by pin 204) and distal end (by pin 205) of bridge plate 150 in either lengthwise or cross-wise positions, are relatively robust, and are of relatively simple fabrication.

5 Left and right hand cam cranks are indicated in Figures 3h and 7a to 7g, as 241, 242. Each cam crank is formed from a bent steel bar. Each cam crank has an inboard hinge portion 244 and an outboard hinge portion 246 that lie on a common hinge axis, 248. As shown in Figures 7f, 7g, inboard hinge portion 244 seats in an aperture or socket 245 mounted to the underside of, and at the laterally outboard edge of, top flange 72, longitudinally outboard of main bolster 120. Outboard hinge portion 246 seats in an aperture 247 formed through side sill 84 (or 86, as the case may be). Socket 245 and aperture 247 act as hinge fittings within which the shaft portions of cam cranks 241 and 242 are constrained to turn. The laterally outboard, or distal, end of hinge portion 246 has a torque input fitting, in the nature of an obliquely angled transverse bore indicated as slot 249. This angle, α , is greater than the outward cant of the side sill web and, in the preferred embodiment illustrated is about 15 25 degrees. Slot 249 admits entry of a lever member in the nature of a turning handle, or pry bar, by which means railroad personnel can impose a turning torque on cam crank 241, 242. As shown, oblique slots 249 are formed in both ends of cam crank 241, 242 permitting the same part to be used as either 241 or 242 rather than requiring fabrication of different left hand and right hand parts. The obliqueness of slot 249 permits a straight bar to be inserted with less tendency, when rotated, to foul side sill 84 or 86 as the case may be. Although slot 249 is preferred, other types of torque input fitting, such as a bent arm (to act as a lever), a lateral pin of shaft, a keyway, a spline or splines, a hexagonal or square head to be engaged by a wrench or socket, an allen head and so on could be used. Slot 249 conveniently does not require the use of a special socket or key of a particular size.

30 A first radially extending member, in the nature of an M-shaped cam throw portion 250 extends between inboard and outboard hinge portions 244 and 246, and will be forced through an arcuate path when a sufficiently large torque is applied though the crank. In so moving, the flattened peaks of the M-shape, indicated as 254, 255, act as cams that work to raise distal portion 239 of bridge plate transition plate 230, (or 232), forcing plate 230 (or 232) to pivot, the proximal end of plate 230 being 35 held down by hinge tangs 234, 236 so that the tip, i.e., distal portion 239 of plate 230 (Figures 6a, 6b, 6c) is lifted clear of bridge plate 150. Flattened peaks 254 and 255 (Figures 7a, 7b, 7c) are provided with bushings, or rollers 257, that bear against the underside of bridge plate transition plate 230 (or 232).

If bridge plate 150 is in an employed, i.e., extended, position when transition plate 230 is lifted, it may tend to want to droop downward since it is cantilevered out over end sill 122 without sufficient reaction force, or weight, at the proximal end to keep the distal end up. A downward droop may tend not to be advantageous when pushing cars together to be coupled, since the distal tip would then have a tendency to jam into the end sill of the adjacent car. It is also not desirable to require railroad employees to have to hold the bridge plate tips up as railcars come together. To that end the middle portion of the M-shape, indicated as 258 has a retainer, in the nature of a protruding catch, pawl, tooth, stop or abutment 260, fabricated in the form of a bent, t-shaped tang 261 with arms welded to either side of portion 258 and the tongue of tang 261 extending above and beyond portion 258. When cam crank 241 is rotated to lift plate 230, abutment 260 is placed in a position to intercept the most inboard edge 262 of sheet 152. When thus engaged, abutment 260 discourages bridge plate 150 from drooping as adjacent cars are brought together.

Further, cam crank 242 can be moved to a fully engaged position to lift transition plate 232 whether or not a bridge plate is present. When the tip, or distal, portion 239 of plate 232 is thus lifted, the distal tip of a bridge plate 150 of an adjoining car can then be introduced, as shown in Figures 8a and 8b. As the tip of the other bridge plate moves into position, it engages the M-shape of cam crank 242 and pushes it backward (i.e., counterclockwise from the viewpoint of a person standing beside car unit 34 facing side sill 86 on the handle side of cam crank 242) to a disengaged position. As this happens, transition plate 232 falls down to engage the upper surface of the incoming bridge plate in an overlapping position. Once the tip of the other bridge plate is on shelf portion 134 (Figure 8d) it can be nudged (if required) into position to permit pin 205 to be inserted.

The sequence of operation for uncoupling two rail road cars such as cars 21 and 22 to permit conversion from "drive-over" ends to a "ramp end" is as follows: Remove the cross-pin from the lower slot of pin 205. Lift pin 205 and place on deck 100. Support the distal tip of bridge plate 150 (can be manually lifted, or alternatively, propped in place). Engage a pry bar or similar bar as a lever in the outboard oblique slot in cam crank 241, and apply a force to the bar to generate a torque to twist cam crank 241 counter-clockwise (as viewed facing the side sill by a person standing beside the car applying force to the lever). This causes the distal edge of transition plate 230 to lift, thereby disengaging plate 230 from bridge plate 150. Engage abutment 260 to edge 262 of bridge plate 150. (The distal tip of bridge plate

150 can be released once abutment 260 is engaged). Engage a pry bar as a lever in the outboard oblique slot in cam crank 242 and twist in a clockwise direction to lift transition plate 232 to a position for receiving another plate. (This step can either precede or follow the step of lifting transition plate 230). Operate the uncoupling rod to unlock the coupler and close the angle cocks (standard steps for uncoupling railcars generally). Pull the rail road cars apart. Rotate (i.e., pivot) bridge plate 150 clockwise (as viewed from above) on pin 204 until toes 88 and 90 rest on shelf portion 134 beneath the overhang of plate 232. Adjust as needed to permit pin 205 to enter collar 200, and install pin 205 to secure the distal end of the bridge plate in place in the stored position. Lower plate 232 to engage, i.e., sit on, bridge plate 150.

To reverse the process: Unlock, and remove pin 205. Use a pry bar as a lever in the outboard oblique bores (i.e., slot 249) of cam cranks 241, 242 to raise intermediate transition bridge plates 230, 232, disengaging them from bridge plate 150. Haul bridge plate 150 out of its storage position by rotating (i.e., pivoting) it counter-clockwise about pin 204 to the extended position, with edge 262 restrained under abutment 260. This is the position shown in Figure 8a. Advance the rail cars towards each other to cause the respective bridge plates 150 to be received under respective intermediate transition plates 232, each bridge plate advancing to encounter cam crank 242 of the opposing railcar, knocking it down as the couplers connect. (See Figures 8b, and 8c). Replace pins 205 of each respective car, nudging or adjusting the bridge plates as required, partially raising bridge plate 232 if necessary to facilitate this nudging, and locking pins 205 in place when seated satisfactorily, thus securing bridge plate 150. Lower plate 230 onto bridge plate 150. Re-establish the coupling between the two cars, including brake lines. The train is again ready to be moved along the rail line.

Alternatively, following the sequence of Figures 8a, 8e, 8f and 8d, when moving the rail road cars together, once the toe of bridge plate 150 (of, for example, car unit 34 of car 22) overhangs shelf portion 134 of the adjacent car (e.g., car unit 36 of car 24), locomotive 38 can be stopped. Bridge plate 150 can be lowered to lie on the receiving portion of the adjacent car, namely shelf 134, by twisting cam crank 242 to release the heel edge, edge 262, of bridge plate 150. The locomotive can continue to urge the cars together, with bridge plate 150 sliding across shelf 134 to meet cam crank 241. The procedure may then continue as before, with re-insertion of pin 205, and so on.

In either sequence, the process includes the steps of positioning the respective bridge plates of the rail road cars in a length-wise orientation and advancing the rail road cars toward each other to cause their respective couplers to mate. The step of advancing includes the step of engaging an extended portion, the distal tip, of each of the bridge plates with a receiving member, shelf portion 134, of the other rail car. The step of positioning each of the bridge plates includes securing the distal tip in a raised attitude relative to the proximal portion, as described above. The step of engaging includes a step of securing each the bridge plate to the other of the rail road cars by re-inserting hinge pin 205 to link slot 186 of each bridge plate with the socket formed by the respective collars, 200.

The step of advancing the cars together is preceded by the step of moving (i.e., raising) transition plates 232 to the raised position to facilitate engagement of bridge plate 150 with the receiving member, namely shelf portion 134. The step of engaging is followed by the step of placing, (i.e., lowering) transition plate 232 to an overlapping position between the received distal tip of bridge plate 150 and vehicle carrying deck 47. The step of raising transition plate 232 includes the step of employing a prop, namely cam crank 241 to maintain transition plate 232 in the raised position. The step of engaging includes advancing the bridge plate to disengage the prop, thus causing transition plate 232 to move to the overlapping position.

On level track, the swinging of bridge plate 150 between length-wise and cross-wise positions occurs in the plane of shelf portion 134, that plane being a horizontal plane, such that rail yard personnel do not need to raise (or lower) the bridge plate to (or from) a vertical, or nearly vertical, position as was formerly common. Further still, since the arrangement of bridge plate 150 can accommodate train motion, whether due to pitch, yaw, roll or uneven spring compression between, for example, car units 34 and 36, bridge plate 150 may remain in its extended, bridging position spanning the gap between units 34 and 36 when rail road cars 22 and 24 are in motion, and does not need to be moved each time the train is loaded or unloaded. Bridge plate 150 may tend not to need to be moved to or from its stowed position except when rail road cars 22 and 23 (or such others as may be joined together) are split apart from their neighbours, or joined together again. This may occur only relatively infrequently to permit the train consist to be changed. This may tend to reduce the number of times rail yard personnel are required to handle the bridge plates, and may tend to reduce the length of time required for loading and unloading.

The process for changing bridge plate 150 from the length-wise position to the cross-wise position is relatively simple: the rail car is established in an uncoupled position by uncoupling the rail road cars and moving them apart, thus disengaging the distal tip of bridge plate 150 from the adjacent car, and establishing bridge plate 150 in the extended position. Pin 205 is removed, transition plate 230 is disengaged from bridge plate 150 by raising its distal portions clear of bridge plate 150. Plate 232 is also raised. Then bridge plate 150 is moved from the length-wise position to the cross-wise position. As noted, the step of moving includes swinging bridge plate 150 in the horizontal plane of portion 134 about the pivot mounting provided by the interaction of pin 204 in collar 200. This is followed by securing bridge plate 150 in place by reinserting pin 205 as a retainer, and by re-engaging transition plates 230, 232, as by lowering them to the overlapping position. The step of disengaging the transition plate from the bridge plate includes the step of operating cam cranks 241, 242 to lift the distal portions of transition plates 230, 232. The step of operating the cam cranks includes the step of turning them to bear against the transition plates.

The process of converting and re-coupling cars can be followed by a series of steps for unloading, and then loading (or re-loading) that include placing ramps at the rail road car ends, as described above and shown in Figures 1a - 1e. In the loading and unloading processes the hostler truck and the highway trailers will cross bridge plate 150 in its stored, or laterally transverse, position.

It may be noted that while telescoping bridge plates could possibly be employed, it is preferred to use a monolithic bridge plate, such as bridge plate 150. That is, bridge plate 150 is a rigid beam. It does not have two beam portions that slide together. The pivot fitting at the proximal end anchored by pin 204, and the combined pivot and slot fitting for engaging pin 205 have a relatively large tolerance, and do not bear either a shear load or a bending moment load when vehicles traverse bridge plate 150. Bridge plate 150 acts as a lintel, or beam, of sufficient length to span the gap between the ends of the two adjacent rail road cars when motionless on straight track, the lintel being supported at either end by two shelves. As such, it has the advantage of comparative simplicity.

The foregoing description has been generally directed to elements related to deck 47 and operational features associated with deck 47. Figures 11a and 11b show the draft gear at the coupler end of rail car unit 34, being representative of the coupler end draft gear of rail road cars 21, 22, 23, 24 and 25 more generally. Coupler pocket 62 houses a coupler indicated as 44. It is mounted to a coupler yoke 378, joined

together by a pin 380. Yoke 378 houses a coupler follower 382, a draft gear 384 held in place by a shim (or shims, as required) 386, a wedge 388 and a filler block 390. Fore and aft draft gear stops 392, 394 are welded inside coupler pocket 62 to retain draft gear 384, and to transfer the longitudinal buff and draft loads through draft gear 384 and on to coupler 44. In the preferred embodiment, coupler 44 is an AAR Type F70DE coupler, used in conjunction with an AAR Y45AE coupler yoke and an AAR Y47 pin. In the preferred embodiment, draft gear 384 is Mini-BuffGear such as is available, for example, from Miner Enterprises Inc., supra, or from the Keystone Railway Equipment Company, of 3420 Simpson Ferry Road, Camp Hill, Pa. As taken together, this draft gear and coupler assembly yields a reduced slack, or low slack, short travel, coupling as compared to a Type E coupler with standard draft gear or an hydraulic EOCC device. As such it may tend to reduce overall train slack, and may tend to reduce the range of travel to be accommodated by bridge plates 150. In addition to mounting the Mini-BuffGear directly to the draft pocket, that is, coupler pocket 62, and hence to the structure of the rail car body of car unit 34, the construction described and illustrated is free of other long travel draft gear, sliding sills and EOCC devices, and the fittings associated with them.

Mini-BuffGear has between 5/8 and 3/4 of an inch travel in buff at a compressive force of 700,000 Lbs. Other types of buff gear can be used that will give an official rating travel of less than 2 1/2 inches, or if not rated, then a travel of less than 2 1/2 inches under 500,000 Lbs. buff load. It is advantageous for the travel to be less than 1.5 inches at 700,000 Lbs., buff load and, as in the embodiment of Figures 11a and 11b, preferred that the travel be at least as small as 1" inches or less at 700,000 Lbs. buff load.

Similarly, while the AAR Type F70DE coupler is preferred, other types of coupler having less than the 25/32" (that is, less than about 3/4") nominal slack of an AAR Type E coupler generally or the 20/32" slack of an AAR E50ARE coupler. In particular, in alternative embodiments with appropriate housing changes where required, AAR Type F79DE and Type F73BE, with or without top or bottom shelves; AAR Type CS; or AAR Type H couplers can be used to obtain reduced slack relative to AAR Type E couplers.

Other than brake and minor fittings, the basic structure of center sill, cross-bearer and decking structure of intermediate car unit 30 is substantially the same as car units 26 and 34. Car unit 26, shown in Figures 9a (isometric), 9b (top), 9c (side view) and 9d (underframe) differs from car unit 34 primarily in having a female set of

side bearing arms, like those of car unit 30 adjacent to car unit 34. The hitch arrangement will be different, with the hitches on all of car units 26, 30 and 34 being arranged such that trailers mounted thereon will have their forward ends (i.e, the end with the king pin) facing toward end portion 64 of car unit 34. Car units 26, 30 and 34 may also vary in their brake arrangements, and other fittings, but share the same basic structural features. However, as intermediate unit 30, shown in Figures 10a (isometric), 10b (top), 10c (side view) and 10d (underframe) has no coupler end, its construction can be conceptualized as having the articulation connection end of car unit 34 taken from a mid span section, with a set of male side bearing arms, and the articulation connection end of car unit 26 with female side bearing arms, also taken from mid-span section, and joining them together in one car, with the pair of female side bearing arms facing car unit 34 and the pair of male side bearing arms facing car unit 30.

Various embodiments of the invention have now been described in detail. Since changes in and or additions to the above-described best mode may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to those details.